Patent Claims

1. Polymer energy absorber for motor vehicles, characterized in that the energy absorber consists of polymer material in the form of a tube and comprises a number of chip-removing elements 2b and that the chip-removing elements 2b are arranged peripherally, so as to be form-fitting and material-to-material, around a central opening in a metal base plate 2 with flange 2a and that the arrangement encloses the tube of polymer material frictionally adhering, thereby causing the absorption of energy through chip removal in longitudinal direction of the polymer tube surface during a crash.

2. Polymer energy absorber for motor vehicles as defined in claim 1, characterized in that tubes made from thermoplastic or duroplastic material are used which are adapted to the motor vehicle weight and the vehicle type.

3. Polymer energy absorber for motor vehicles as defined in claim 1 and 2, characterized in that the energy absorber tube of polymer material is composed of one of the materials from the group of polyvinyl chlorides (PVC), polyethylenes (PE), polypropylenes (PP), polyamides (PA), polycarbonates (PC), polyethylenterephthalates (PET), polybutylene-terephthalates (PBT), polymethylmethacryaltes (PMMA), polyoxymethylenes (POM), styrene copolymerisates (acryl-nitrile-styrene-butadien copolymer and copolymer from styrene and acrylnitrile), as well as blends thereof (ABS/PC and PBT/PC).

4. Polymer energy absorber for motor vehicles as defined in claim 1 and 2, characterized in that the energy absorber tube of polymer material is composed of a high-performance polymer material from the group polyetherketones (PEK, PEEK), polyamides and their copolymers.

5. Polymer energy absorber for motor vehicles as defined in claims 1 to 4, characterized in that polymer blends are used as material for the tube-shaped energy absorber of polymer material.

6. Polymer energy absorber for motor vehicles as defined in claims 3 to 5, characterized by the admixture of inorganic filler materials such as chalk, talcum, carbon fibers, glass fibers, mica, silicates, aluminum nitrite and aluminum silicate and metal micro-particles for improving the mechanical stability and rigidity of the energy absorber tube of polymer material.

7. Polymer energy absorber for motor vehicles as defined in claim 6, characterized in that the share of added inorganic filler materials is in the range of 3 to 40 percentages by weight, relative to the mol weight of the energy absorber tube of polymer material.

8. Polymer energy absorber for motor vehicles as defined in claims 3 to 5, characterized by the admixture of nano-particle filler materials such as TiO_2, soot,

silicic acid and clay minerals with particle sizes of 80-150 nm, at a share of 3-15 percentages by weight, relative to the mol weight of the polymer energy absorber tube.

9. Polymer energy absorber for motor vehicles as defined in claims 1 to 8, characterized in that the outer tube diameter of a polymer energy absorber tube is in the range of 4 to 10cm.

10. Polymer energy absorber for motor vehicles as defined in claims 1 to 9, characterized in that the tube wall thickness of a polymer energy absorber tube ranges from 0.5 to 10cm (corresponding to solid material strength).

11. Polymer energy absorber for motor vehicles as defined in claims 1 to 10, characterized in that the total length of a polymer energy absorber tube ranges from 35 to 200 mm, depending on the design for an energy absorption in the range of up to 20 kJ.

12. Polymer energy absorber for motor vehicles as defined in claim 11, characterized in that the total length of a polymer energy absorber tube preferably ranges from 100-170mm and depends on the space provided for the installation in a motor vehicle, on the energies to be absorbed, and on the dimensioning for a crash speed range of up to 20 km/h.

13. Polymer energy absorber for motor vehicles as defined in claims 1 to 12, characterized in that the polymer energy absorber tube is composed of at least two layers of the same and/or different layer thickness and of identical and/or different polymer materials, as defined in claims 3 to 5.

14. Polymer energy absorber for motor vehicles as defined in one of the preceding claims, characterized in that the density of the thermoplastic and/or duroplastic materials used for the multi-layer composition of the polymer energy absorber is in the range of 0.82 to 1.48 g/cm^3.

15. Polymer energy absorber for motor vehicles as defined in one of the preceding claims, characterized by a metal inlay and/or a textile reinforcement that is deposited over the complete or partial substrate for a multi-layer composition, so as to improve the shearing force resistance as defined in patent claim 13.

16. Polymer energy absorber for motor vehicles as defined in claims 1 to 12, characterized in that a tubular basic body of metal, as defined in patent claim 13, is coated and that the deposited polymer layers form the energy-absorbing chip-removal layers.

17. Polymer energy absorber for motor vehicles as defined in claims 1 to 16, characterized in that the geometric cross-sectional shape of the energy absorber tube is either circular, U-shaped, trapezoid, rectangular or elliptical.

18. Polymer energy absorber for motor vehicles as defined in claims 1 to 17, characterized in that a polymer energy absorber tube is produced using the extrusion, co-extrusion and/or injection-molding technique.

19. Polymer energy absorber for motor vehicles as defined in claims 1 to 18, characterized in that the energy absorption through material removal is achieved for crash speeds of up to 20 km/h in longitudinal direction of the energy absorber tube surface by means of a number of chip-removing elements 2b which are connected frictionally adhering to the polymer tube surface.

20. Polymer energy absorber for motor vehicles as defined in one of the preceding claims, characterized in that by adjusting the number, the geometric form and the cutting depth (penetration depth) of the chip-removing elements 2b, the energy absorption can be adjusted for up to 20 kJ.

21. Polymer energy absorber for motor vehicles as defined in one of the preceding claims, characterized in that the chip-removing elements 2b have an energy-absorbing effect while moving along the inside surface or in a combination

arrangement the outside and inside surface of the polymer tube, as defined in patent claim 1.

22. Polymer energy absorber for motor vehicles as defined in claims 19 to 21, characterized in that the number of chip-removing elements 2b ranges from 4 to 40.

23. Polymer energy absorber for motor vehicles as defined in claim 22, characterized by 8 to 16 chip-removing elements 2b, arranged symmetrically and equidistant as well as peripherally.

24. Polymer energy absorber for motor vehicles as defined in claim 22, characterized in that the spacing between the individual chip-removing elements 2b is in the range of 2.5 to 25%, relative to outside and/or inside periphery of the polymer energy absorber tube.

25. Polymer energy absorber for motor vehicles as defined in one of the preceding claims, characterized in that the chip-removing elements 2b have a rectangular, triangular, trapezoid, polygonal, or semi-circular shape and form a chip-removing angle of 45-90 degrees, relative to the normal for the polymer energy absorber tube outside and/or inside surface.

26. Polymer energy absorber for motor vehicles as defined in one of the preceding claims, characterized in that the length of a chip-removing element 2b is 0.5-3cm, adapted to the wall thickness of the polymer energy absorber tube and results in a material penetration depth Δd of 0.15 to 1.5 cm.

27. Polymer energy absorber for motor vehicles as defined in one of the preceding claims, characterized in that metal, or metal alloys, or ceramics are used as material for the chip-removing elements 2b.

28. Polymer energy absorber for motor vehicles as defined in one of the preceding claims, characterized in that a guide sleeve 5 is attached integrally to the metal base plate 2 with flange 2a, thus permitting an axially guided movement of the polymer energy absorber, and that the guide sleeve 5 functions as momentary support in case of a crash.

29. A bumper system for motor vehicles, comprising at least two polymer energy absorbers as defined in claims 1 to 28.

30. The bumper system for motor vehicles as defined in claim 29, characterized in that the polymer energy absorbers are installed in front of a vehicle frame side rail and that the polymer energy absorber tubes are connected form-locking and/or frictionally adhering by means of fastening elements and the flange 2a of the

metal base plate 2 for the energy absorber to a vehicle frame part 7 that is positioned behind.

31. The bumper system for motor vehicles as defined in claims 29 and 30, characterized in that the energy absorber is connected integrally to the bumper support and that this connection to the bumper support is form-locking and material-to-material or form-locking and frictionally adhering.

32. The bumper system for motor vehicles as defined in claims 29 to 31, characterized in that the bumper system is used in the rear region of a motor vehicle.